WATER TREATMENT

Edited by **Walid Elshorbagy**
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Preface

Economic development, population growth, and environmental pollution evolving in many parts of the world are placing great demands on existing resources of fresh water. Arid and/or semi-arid regions in particular suffer major shortage of fresh water supplies due to the scarcity of available natural and traditional resources. Fresh water may seem to be commonplace on earth, but it is actually scarce. Most of the world's water is saline where 2.5 percent only is fresh, and 97 of that freshwater is tied up in the north and south poles, and in underground water. Only the remaining 0.3 percent is renewable through the cycle of precipitation and evaporation, and even this is often not available where and when it is needed. The demand for freshwater is doubled every twenty years. In 1950, only 12 countries with 20 million people faced water shortage and this rose to 26 countries by 1990 with 300 million people. By 2050, it is projected to be as many as 65 countries with seven billion people, or about 60 percent of the world's population, mainly in the developing countries. The Gulf Cooperating Council Countries (GCCC) have had water shortages in the past, and they continue to be susceptible to water shortages in the future due to their geographic location in an arid zone.

Emerging trends indicate that a "water crisis" is now approaching in several regions - most notably the Middle East and North Africa - where per capita water availability is 1,247 cubic meters per year, one of the lowest in the world. Thus, the main constraint to agricultural production in these areas in the near future will be the availability of water, not land.

In line with resolving the water crisis in recent years, there has been an increasing concern on the improvement and development of the water sector (resource management) and the efficient utilization of the water resource (demand management) for sustainable development. Above all, water purification is a vital alternative to eliminate the water contamination and to close the gap between fresh water demands and available resources. Treatment and purification approaches include traditional approaches that have lasted for several centuries without major changes and/or modifications. Recent modifications to treatment approaches as well as advanced and new innovative approaches have been emerging and reflecting their significant contribution towards fixing the water crisis.

This book covers a number of water treatment issues relevant to either improving the common traditional treatment methods or to new advanced and innovative approaches. It has four sections titled: [1] Management and Modeling of Treatment Systems, [2] Advanced Treatment Processes, [3] Treatment of Organic-contaminated Water, and [4] Advanced Monitoring Techniques. The first section addresses three topics; the first is related to Informatics, Logistics and Governance in Water Treatment where issues like data requirements for water treatment and water supply scheme, governance in water treatment and water supply scheme, water-energy nexus, and intelligent systems in water process are discussed. The second topic introduces an alternative approach to design water treatment plants that applies systems analysis successfully and productively based on their concept and practice of the optimization theory. The third topic reviews modeling approaches and mathematical formula used in predicting the quality of wastewater treatment plants (WWTPs) effluents. Such review has a great benefit in carrying out assessment studies of WWTPs impacts on the receiving water bodies.

Second section has seven chapters addressing different advanced water treatment processes. This includes a comprehensive review on wastewater treatment methods, particularly advanced oxidation processes, absorption, and electrochemical technologies along with discussion of advantages and disadvantages of each method. The section has another chapter on the usage of natural zeolites as excellent adsorbents for the removal or reduction of toxic cations and anions from drinking water, wastewater, surface, underground and public municipal waters. Another chapter evaluates the combined usage of natural coagulation/flocculation and microfiltration in the removal of cyanobacteria from drinking water. Following chapter evaluates the role of biologically activated filters in contaminant removal from water sources and in selecting microbial communities in biofilms specifically adapted to targeted contaminants for efficient metabolism. Section II also discusses the application of bubble flotation technique in industrial waste water treatment, particularly in heavy metal removal. Another chapter evaluates different treatment techniques in removing inorganic and organic contaminants from produced water generated during oil and gas extraction from subsurface formations. Finally this section has a chapter evaluating different treatment techniques in removing major contaminants in groundwater in Denmark with focus on contaminants like turbidity-producing matters, arsenic, chlorinated solvents, and pesticides.

Section III has two chapters on removal of organic contaminants from wastewater. While the first chapter presents a comprehensive review of the types and sources of organic contaminants in wastewater along with their common remediation techniques, the second focusses on the use of electrochemical technologies in separating such organic contaminants from water.

For Section IV, three chapters present different techniques and programs of water quality monitoring. The first presents a brief report on the use of bioassays with

plants, especially Allium cepa, in monitoring the quality of water. The second evaluates different types of Algae as bioindicators used in evaluating the water quality and treatment efficiencies. The third chapter compares the results of intensive monitoring program applied to the polluted and heavily eutrophicated Palic Lake in the past 20 years with its quality after being dried and restored in 2010. This is in addition to perceive the possibility of applying ecoremediation technologies in remediation of Palic Lake.

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